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A Study on Project Cycle and Project Risk Management: A Case of Highway Construction Project

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Abstract

Practitioners are constantly creating awareness of the need to construct highway infrastructure projects to support the growth of world population and upgrade the existing infrastructures to support the fundamental services that directly impact people's living habits, in the hope of reducing poverty and fostering economic development, trade, and technical cooperation. The project cycle management and project risk management are powerful tools on which to achieve these objectives. This study seeks to investigate the factors responsible for projects failure particularly in the highway construction projects within the frame work of risk identification, risk assessment, analysis, treatment, monitoring and control using Fuzzy linguistic approach, Kendal's Concomitant Rank Approach and Sensitivity analysis. The findings of the study are that Project implementation should be aimed at focusing on specific; measureable; achievable; realistic and time bound alternative scenarios and that prudent risk management approaches may offer solution to achieving project goal. This study contributes to current literature by providing a qualitative understanding of relationship between project cycle management and project risk management in developing and developed countries. This understanding is important for academics, project managers and policy makers in shaping the future stability of infrastructural projects and hence economic growth.

Keywords: Project Cycle, Project Risk Management, Highway Construction Project, One Belt and One Road Project and Economic Growth

1. Introduction

The relationship between project cycle development and project risk management is a controversial topic because we are most concern about poor performance in project management that can lead to cost increase (project cost overrun); loss or reduction in project

satisfaction/utility, delay to complete project on time, reputation issues and insolvency/stalled projects and thus have a negative effect on the socio-economic growth. This research does not undermine project failure and the devastation it may cause on the society and the overall growth climate.

We have seen recently the world population is rising exponentially and demands for additional and more efficient infrastructure are increasing in all sectors. Practitioners are constantly creating awareness of the need to build infrastructures to support the growth of world population, and upgrade the existing infrastructures to support the fundamental services that directly impact people's living habits. In 2005 the American Society of Civil Engineers (ASCE) reported that the critical infrastructure of the United States was outdated, and in 2008 the President of ASCE presented a testimony in the US congress to recommend a substantial commitment and investment in infrastructure construction and upgrades as part of the economic development plan and to meet the current demands of population increase (ASCE, 2008). The project cycle management entails identification, feasibility and appraisal, negotiation/financing, implementation, monitoring and evaluation and post evaluation and is a powerful tool on which to achieve this goal (Zayed, et al, 2009).

It can be analogous to infer that it is in the same spirit that the "One Belt and One Road" project which has the potential to offer solution to the growing needs in Asia and may help to reduce poverty and fostering economic development, trade, and technical cooperation in the Asia continent is proposed. Therefore, the implementation of such a laudable initiative will enhance peace, security, stability, regional integration and hence economic development among its member states. However, two of the weaker areas that international development infrastructure projects need to improve, according to the World Bank (2007), were: (i) the prediction of realistic outcomes (i.e.: cost, safety, scope and schedule), (ii) the achievement of accurate results when compared to a benchmark. World demand of infrastructure is expected to rise and public owners are increasingly challenged by stakeholders to optimize the use of available funds to maximize the delivery of infrastructures (Zhang, 2005a).

The global need for infrastructure investment and improvement of its efficiency as argued by Tah et al., (2001) is due to increasing demands, and also to market and government failure worldwide; market failure, because of significant inefficiencies and limited competition; and government failure, in terms of its slow and infective decision making and implementation. Both infrastructure development and implementation efficiency are needs that have to be satisfied, and they are forcing industry practitioners to create new methods to deliver infrastructure projects on-time and on-schedule. One approach is the application of alternative delivery methods, like Public-Private Partnership (PPP) that aids funding and increases synergy between public and private entities based on trust, allowing more capital availability for the development of infrastructure. Other approaches are based on improving efficiency and predictability to maximize the use of the available resources; an example of this is the application of risk identification, analysis and mitigation techniques that provide owners with tools to predict and prepare for the difficulties during construction. Innovations in both areas are needed to fulfill a demand that is only expected to increase in the future. However, project risk management particularly with highway

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construction infrastructure projects is often ignored.

The highway construction project has numerous uncertainties and risks, which increase with respect to the size and the complexity of a project and often fraught with risk and uncertainty. However, engineers, project managers and cost estimators often overlooked or failed to recognize project risks and uncertainty early in the project development process. As a result they do not communicate project uncertainty, risk and its effects to stakeholders.

Project Management Institute (PMI) defines project risk as an uncertain event or condition and that its occurrence has positive or negative effect on at least one project objective, such as time, cost, scope, or quality (PMI 2004). Uncertainty' refers to the occurrence of an event about which little is known. Project risks may have one or more causes and impacts, and project risk management might be formal or informal process. Project risk management includes the process concerned with conducting risk management planning, identification, assessment/analysis, responses/treatment, and monitoring and control on a project; most of these processes are updated throughout the project. Ashley et al., (2006) have emphasized the importance of risk assessment, risk allocation, and risk management in effective management of highway construction projects. These scenarios may not be an exception to the proposed highway construction project of the "One Belt, One Road" construction project and could pose potential impediments to the project life cycle and management.

Now that growth promotion in the highway construction project is being actively supported by the International Monetary Fund (IMF), the World Bank and other International Financial Institutions (IFS) including Governments, all these efforts requires research to find out the link between project cycle development and project risk management. The highway construction project management provides good laboratory test as it has fraught with problem of quality and safety; time management (program /schedule), scope and change management; procurement and contracts; information management and; external influence (the macro and legal environment) and people management for a very long time.

Given the abysmal and poor construction of highway projects in recent times, even with the introduction of the IMF and the World Bank adjustment programmes coupled with governments' initiatives and support to highway construction projects; the following questions becomes imperative and concern; (i) What are the factors responsible for the poor performance and failure in highway construction project and its implication on the socio-economic growth and development of nations? (ii) Can prudent project cycle development design useful for the stability and mitigation of project risk management in terms of increased productive investments and hence economic growth?

To this end, a comprehensive project cycle development and risk management approach can help project team identify, assess, mitigate and control project risks. Another benefit of risk management approach is the ability to generate range of estimates early in the project development process and to establish justifiable contingencies with the aim of achieving project objectives. This understanding is important for academics, engineers, project owners, development partners and policy makers in shaping the future stability of the highway construction projects regarding quality, time and cost efficiency globally. These issues therefore,

motivate the study.

Therefore, the purpose of this paper is to design tools that owners of construction projects can use to minimize risks of failures, and increase the chances of appropriate measures that construction projects will meet their desired outcomes (cost, safety, scope and schedule) and provide a method for owners that will aid them implementing more efficient and predictable infrastructure projects throughout the project cycle phase.

Primary weakness of the study is the qualitative assessments of risk ranking factor; analysis is therefore restricted to a smaller number of risk management approaches than desired because of these restrictions. Despite, the qualitative assessments of risk management approaches, the study is still relevant and provides solid foundation of achieving broad based stability in the project cycle development and project risk management. The rest of the section is organized as follows; section 2 is project management general review, section 3 provides project management evaluation techniques with particular focus on appropriate measures to be adopted in the highway construction projects and finally section 4 is conclusion.

2. Project Management General Review

This section reviews theory in the context of developing and developed countries and to review a broader literature strand on the connection between Project cycle development and project risk management. This connection is very crucial and important in the understanding of carrying out an evaluation on project management discourse. The project cycle development is a powerful tool on which to analyze project formulation and development because it guides project practitioners and policy makers including governments to fully understand the stages of the cycle before a project can be considered for implementation. These stages include but not limiting to the following as detailed in the diagram below:

- Project Identification
- Feasibility
- Appraisal
- Negotiation/Financing
- Implementing

Project Identification: This part of the cycle is the first stage and entails the meeting of stakeholders to discuss about the purpose of the project to be undertaken. Members of the community in which such project is to be undertaken are well informed and explain the benefits of the project to the society in particular and the players of the project in general. This will provide the basis for the society to be given the opportunity to have a say in such project and determining whether such project is beneficial or not. Projects should not be imposed on society because it may not be their felt needs. (Lemos et al, 2004). To this end, the "One Belt and One Road" project should be extensively discussed with the society and the stakeholders/ players involved with a view to have a common understanding of project benefit and cost, this will increase the chances of the project to be feasible for implementation.

Feasibility: This is the nature and scope of the

project development process. In this stage the planning and designing of the project is being made. It is done in a documentation form. According to the World Bank report on projects (2010), project benefit and cost are highlighted and communicated to the community and the parties' involved at this stage of the project cycle, where the project is going to be located and when it is to commence and complete. This stage provides answers to the following questions; (i) what is the time frame to be put in place that is how long each activity or stages of the project will last? (ii) The risks that would be involved, how are people going to be recruited in the project work? ; (iii) When such people involved in the work and how would they be laid off when their own parts of the work are completed or they do not meet up to the rules and regulations of the project objectives or carrying out the work?; (iv) If there are risks how can such risks be managed and how stakeholders would be communicated to? These are some of the issues that should be looked into in the feasibility stage of the "One Belt and One Road", if the project should be realistically and smoothly implemented.

Appraisal: In this stage the project work is being appraised taking into account the calculation of cost and benefit. Usually, project managers and designers use the net present value, the internal rate of return and or the cost benefit analysis to appraise a project and determine whether the project can be executed. Procurements and contracts procedures, financing plan and disbursement and monitoring and evaluation, periodic reports/review conditions are detailed at this stage regarding project implementation through the Project Appraisal Document (PAD) and Project Manual (PM) to ensure that project objectives are on track and progressing. Therefore, this stage provides the basis to guide the smooth implementation of projects (Tah, et al., 2000).

Negotiation / Financing: At this stage the partners of the project discuss the means by which the project is to be financed, the financing obligations of parties to the project, negotiations of certain requirements and terms leading to the fulfillments of certain conditions prior to effectiveness of the project.(Alasdair, 2003). To this end, it could be seen that signing of the project financing date does not necessarily implies that the project can be financed immediately, unless and until certain conditions are fulfilled before the project can be considered for declaration of effectiveness and disbursements made.

Implementing or Executing: At the stage the equipment and all other items proposed to be used are now put into action in accordance with project management plan to accomplish the requirements and goal of the project. This process involves the coordination of the people and resources. Project Management Unit/ executing agency and the oversight authorities of the project (Saaty, 2002).

Monitoring and Evaluation: Monitoring focuses attention on how quickly and effectively problems are solved in the project. The problem of the project may be internal or external more especially if the project is co-financed. This stage should ensure that funds are prudently utilized for the purpose of the project to ensure smooth implementation that will enhance project objectives. In monitoring, the issue of change may likely come in. In this phase errors can be corrected. It can be manpower or the design; the materials used etc. All these changes are to be documented in the contract documents. It must be documented because it is a rule of thumb in construction project, to ensure the success of smooth project implementation.

Through monitoring the project outcomes can be effectively evaluated and a tool to track progress of the project (Smith et al, 2006).

Post Evaluation: It is the case that the project may have closed due to project completion. However, stakeholders or financiers may consider it prudent to evaluate whether the project was beneficial and is being well utilized in accordance with the intention it was initiated for. This gives an opportunity to stakeholders to re-focus on other priority areas of project development all in the name to meet the growing needs of population and society for socio-economic development.

However, at the stage of the project cycle development there are associated risks that must be properly managed or mitigated to achieve project objectives particularly for construction projects. As Zou et al. (2007) noted "no construction project is risk free, risk can be managed, minimized, shared, transferred or accepted. It cannot be ignored" Moreover, construction projects are exposed to more risk and uncertainty than perhaps any other industry sector. It involves numerous stakeholders, long production durations and an open production system, entailing significant interaction between internal and external environments. Such organizational and technological complexity generates enormous risks. It appears that risk assessment is a controversial issue, however, it is frequently considered to be the most useful part of the risk management (RM) process (Smith et al., 2006).

Generally, risk management includes: risk identification, risk assessment and risk response (Al-Bahar, 1989). It is clear that risks should be assessed before being responded to. Usually, there are two ways to assess risks, qualitative, and quantitative (Ezekiel and Alasdair, 2003). To execute a pro-active risk assessment, statistical analysis is ideally employed to do the quantitative assessment. But most risks are difficult to quantify because the underpinning information is usually unavailable or insufficient. Therefore, there was no project virtually run its full course. In this case, risk assessment methods used to date are mainly qualitative.

Lemos et al., (2004) studied two bridges cases in Portugal, which includes an overview of the project's background and an analysis of the main risk categories stating both the actual risks encountered and the mitigation measures. The risk factors were classified into 6 categories: Social, Legal, Economic, Environmental, Political and Regulatory and Technological, which included not only the technical factors but also a realistic assessment of environmental and social risks.

Having reviewed these different literature to project management discourse, the next part of the paper will analyze and discuss risk management approaches spanning from risk identification, assessment, analysis, treatment, monitoring and control within the framework of Kendal's Concomitant Rank Approach, Sensitivity analysis, Probability theory and Linguistic variables in the highway construction projects in an attempt to draw informative conclusions and create an agenda for policy recommendation and further research.

3. Risk Management Approaches in the Highway Construction Project

Project risk management strategies includes the process concerned with conducting risk management planning, identification, assessment/analysis, responses/treatment, and monitoring and control on a project.

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3.1 Risk Identification

Risk identification is the first and perhaps the most important step in the risk management process, as it attempts to identify the source and type of risks. Risk identification is defined as detecting, classifying, and documenting the risks influencing on the project and their specifications. It includes the recognition of potential risk event conditions in the construction project and the clarification of risk responsibilities (Wang & Chou, 2003). Risk identification develops the basis for the next steps: analysis and control of risk management. Corrects risk identification ensures risk management effectiveness. (Widerman, 2004) stated that the identification and mitigation of project risks are crucial steps in managing successful projects. Many approaches on risk classification have been suggested in the literature for effective highway construction project risk management.

Risks can be categorized into two groups in accordance with the nature of the risks, i.e. external and internal risks. According to Wang et al., (2004), the category of the risks depends mainly upon whether the project is local or international. The internal risks are relevant to all projects irrespective of whether they are local or international. International projects tend to be subjected to the external risk such as unawareness of the social conditions, economic and political scenarios, unknown and new procedural formalities, regulatory framework and governing authority, etc. loss of life, through automobile crashes in terms of tens of thousands of motorist suffering injury or property loss and damage in highway work zones. The travelling public, designers, transport agencies, contractors will all benefit if these hazards are reduced thorough prudent risk management (Smith, 1999).

The primary factors that contribute to work zone crashes involving injuries or fatalities and the mitigating strategies have been focused on physical measures taken during construction, some of these factors include but not limited to the following; speed, inattentive driving, following distance, aggressive /dangerous driving and large trucks (Roadway safety foundation, 2007). The leading types or causes of work zones accidents are rear-end collision, workers struck by motorist, workers struck by construction equipment (when mostly backing up) and motorist collision with large trucks (Garber, 2002: Huaman, 2007). In addition, the time in which work-zones accidents are most likely to occur has been determined by night time (dark), Fridays, evenings of weekends (after bar time), summer months and period of heavier traffic (Pratt, 2001: Pigman, 1990).

A number of documents and tools are available to support the risk identification process. Table 1 provides an example of project-specific documents, programmatic documents, and techniques available for risk identification.

Table 1: **Risk Identification tools and techniques**

Project-Specific Documents	Programmatic Documents	Techniques
Project description	Historic data	Brainstorming
Work breakdown structure	Checklists	Scenario planning
Cost estimate	Final project reports	Expert interviews

Design and construction schedule	Risk response plans	Nominal group methods
Procurement plan	Organized lessons learned	Delphi methods
Listing of team's issues and concerns	Published Commercial databases	Crawford slip methods
	Academic studies	Influence or risk diagramming

Source: (Zou and Zhang, 2007)

3.2 Risk Assessment

Risk assessment involves measures, either conducted quantitatively or qualitatively, to produce the estimation of the significance level of the risk factors to the project, so as to produce the estimation of the risk of the potential factors to project success. The primary objective of risk assessment is to estimate risk by identifying the undesired event, the likelihood of occurrence of the unwanted event, and the consequence of such event. However, results of risk assessment will become the input to the determination of the optimum decision. With a better quantification measuring result, the managers can recognize which risks are more important and then deploy more resources on it to eliminate or mitigate the expected consequences.

3.2.1 Sources of Risks

Although project risks are interrelated and interdependent, most risks spring from a definite origin. The customary origins for project risks are the following:

- Performance, scope, quality, or technology issues
- Environment, safety, and health concerns
- Scope, cost, and schedule uncertainty
- Political concerns

3.2.2. Risk Assessment Approaches

Risk assessment methods have ranged from simple classical methods to fuzzy approach mathematical models. Many construction project risk assessment techniques currently used are comparatively mature tools (Han et al, 2008). Sensitivity Analysis and critical path methods are the classical quantitative methods, used in construction industry for risk assessment. These methods only use data that are quantitative. For effective application of these sophisticated quantitative techniques high quality data are a prerequisite (Zen et al., 2007). Only on a few projects and contracts are risk considered in a consistent and logical manner; much assessment is too subjective (Mills, 2011). So, some other models suggested, involve both quantitative and qualitative ones.

However, this study will focus on few qualitative approaches to risk assessment and analysis which are commonly used in the highway construction projects; namely the linguistic triangular fuzzy numbers, the ranking factor criteria, sensitivity analysis. These tools are designed to remove or reduce the risks

which threaten the achievement of project objectives. It involves the analysis of the qualitative data obtained and procedures as applied to determine the probability and the impact of the risks. It is split into two sub-stages; qualitative analysis that focuses on identification and subjective assessment of risks and a quantitative analysis that focuses on an objective assessment of the risks. Usually it takes the form of assessment which could be the description of each risk and its impacts or subjective labeling of each risk (e.g. high/ low) in terms of both its impact and its probability of occurrence. Identification in this stage can be achieved by:

- Interviewing key members of the project team.
- Organizing brainstorming meetings with all interested parties.
- By using the personal experience of the risk analyst.
- Reviewing past corporate experience if appraisal records are kept.

3.2.2.1 Linguistic variables

A linguistic variable is essentially the variable represented by a word or a sentence in human languages. A linguistic scale of degree of impact is shown below in table 2a and 2b:

Table 2a Linguistic scale of degree of impact

Semantic scale	Triangular fuzzy numbers
Absolutely unserious	(0, 0, 0.1, 0.2)
Very unserious	(0.1, 0.2, 0.2, 0.3)
Unserious	(0.2, 0.3, 0.4, 0.5)
Average	(0.4, 0.5, 0.5, 0.6)
Serious	(0.5, 0.6, 0.7, 0.8)
Very serious	(0.7,0.8.0.8.0.9)
Absolutely serious	(0.8,0.9,1.0,1.0)

A linguistic scale of occurrence likelihood is shown below:

Table 2b Linguistic scale of occurrence likelihood

Semantic scale	Triangular fuzzy numbers
Absolutely unlikely	(0, 0, 0.1, 0.2)
Very unlikely	(0.1, 0.2, 0.2, 0.3)
Unlikely	(0.2, 0.3, 0.4, 0.5)
Average	(0.4, 0.5, 0.5, 0.6)
Likely	(0.5, 0.6, 0.7, 0.8)
Very likely	(0.7,0.8.0.8.0.9)
Absolutely likely	(0.8,0.9,1.0,1.0)

Source: Zeng et al., 2007

3.2.2.2 The Ranking Factor Criteria (Kendall's concomitant Approach)

Risk factors are presented in table 3a to be hypothetically ranked in order to assess the magnitude of risks regarding schedule of delay.

Table 3a: Risk factors

Risk Factor	Definition
R1: **Political / Social Instability**	Civil unrest, riots, political turmoil or crisis, general strikes, abrupt presidential or parliament replacement, war.
R2: **Political interference**	The instances when the implementation agency is abruptly overruled by an external political factor. Also seen as general government overruling the decentralize agencies.
R3: **Force Majeure (nature).**	Is a natural event that cannot be reasonably anticipated or controlled, e.g.: earthquake, floods, landslides, unseasonable torrential rains, cyclones or hurricanes, *etc.*
R4: **Change in country priorities.**	When the nation changes the priorities and either the central government or the parliament or both lose the motivation to keep supporting the project/program.
R5: **Lack of security in work areas.**	When the areas where work is to take place lack of security with respect to human rights and/or property rights and safety for workers and engineers.
R6: **Lack of private sector support.**	Absence of response from contractors or consultants to the request for proposals or lack of interest by the parties expected to act as partners or in a financing structure (PPP, BOT, etc).
R7: **Sponsor delays.**	When a country needs an intermediate approval from the sponsor to re-evaluate the scope and approve changes, and the process is delayed
R8: **Lack of counterpart funds or delay in allocation.**	When the host country takes longer than expected to approve and transfer counterpart funds to be used by the implementation agency, affecting the implementation cash flow.
R9: **Macro-economic volatility**.	Economic recession, large inflation rates, large currency devaluation, restrictions in currency exchange, lack of economic predictability.
R10: **Disbursement difficulties.**	The weakness of the implementation agency to distribute the available funds in a timely manner. Sometimes the

	established billing process clogs the system extending the duration of the billing cycles.
R11: **Crisis in the region (Financial or Market implications)**	This happens when regional crisis affects the host country with financial difficulties, shifting their attention and their capacity to cope with their budget limitations. Also, when markets and the availability or cost of resources are affected.
R12:**Contractor / Designer delays or inefficiency**	Delays caused by constructability problems with design, utility relocation delays, contractors default, lack of man-power, limited contractor's capacity or experience to handle the projects awarded, inadequate supply of local resources, weak subcontractors, *etc.*
R13:**Change in project scope**	When the original scope is either expanded or reduced or changed to a level that significantly affects the outcome.
R14: **Institutional changes**	Transformation or restructuring of implementing agencies, frequent turnover in leadership or key staff of implementation agency, changes in ministries and its coordination personnel.
R15: **Procurement delay**	Inability of implementation agency to award contracts to designers, consultants or contractors in a timely manner.
R16**: Ineffective management of agency**	Limited authority, lack of technical/expert staff to perform mandated tasks, lack of effective leadership, weak administrative capacity; poor monitoring, poor financial management and accountability of agency staff.
R17:**Slow land acquisition by agency**	When land acquisition delays affect the commencement or continuation of work.
R18:**Central-localagenciesmiscommunication**	Disconnect between agencies in the host country, creating either duplication and conflicting efforts, or areas with lack of responsible party.
R19: **Delay compiling data by agency (Sponsor requirements)**	Inadequate familiarity with sponsor's (World Bank in this case) procurement guidelines. Problems with progress reports, performance indicators, *etc*. Also in some instances the host country is required to communicate to the sponsor, either to request release of funds, or to request an extension of time money or change of scope. If proper procedures are not followed in these communications, delays may ensue
R20:**Limited experience**	Lack of experience of implementing agency with international bidding process and contracting. Limited experience to manage large number of contract changes with contractors. Inexperience staff employed .Limited capacity to lead a project of this size.

Source: Al- Bahar. (1989)

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From table 3a above, the quantification model to rank the risk factors can be seen as a conditional process. First, we know from the sample that a risk factor either happened for a project, with an occurrence equal to the calculated frequency from the sample, or did not happen; then after this condition, if the risk happened for a project it had an impact over the response variable. If the risk didn't happen, the impact over the response variable was zero (0). Then we can define the conditional mean weighted impact as the multiplication of impact and frequency, Table 3b presents the results of the mean impact weighted by the relative frequency for each risk factor. Baccarini and Archer (1999)

Mean weighted impact = Mean impact x Frequency of occurrence. Thus, the hypothetical situations from which the values are taken at random to demonstrate the idea of ranking risk factor as shown in table 3b below:

Table 3b: Risk factors impact over schedule delay weighted by frequency.

Risk Factor	Mean Impact (%)	Frequency (%)	Mean weighted Impact (%)
R1	12.62	28.1	3.55
R2	11.46	23.6	2.71
R3	-9.51	31.5	-2.99
R4	10.10	14.6	1.47
R5	-19.93	5.6	-1.12
R6	28.80	3.4	0.98
R7	10.84	3.4	0.37
R8	12.36	47.2	5.83
R9	-7.77	36.0	-2.80
R10	-13.70	29.2	-4.00
R11	3.76	19.1	0.72
R12	1.33	29.2	0.51
R13	9.65	38.2	2.60
R14	-1.87	39.3	-0.74
R15	14.32	41.6	5.96
R16	-5.65	33.7	-1.90
R17	3.45	12.4	0.43
R18	6.96	28.1	1.95
R19	-3.23	22.5	-0.73
R20	-1.31	2.02	-0.26

(Authors estimation): Mean impact and Frequency are hypothetically subjective values.

Table 3c below presents the risk factors ranked from the larger to the smaller weighted impact. This distribution of values takes into consideration both impact of the risk factor over a typical project and the proportion in which the factor appeared as a threat in the project domain, defined by the frequency of occurrence. The meaning of this weighted impact will not represent the proportion of the data that this factor is responsible for, but it will provide us with a coefficient to weight the effect of one factor against the others. We will set a threshold point for the most important risk factors when

the weighted impact values exceed 1% and will call the factors falling in that group "First tier factors". Another threshold for a secondary set of important risk factors is set with weighted impact values between 0.25% and 1% and the factors falling in that group will be called "Second tier factors". A special comment will be made for "Critical" risk factors with mean weighted impact values exceeding 5%. Table 3c presents the first threshold below "R4" and the second threshold below "R7", over schedule delay weighted by frequency.

Table 3c: Risk factors ranked from the larger to the smaller weighted impact.

Risk	Weight impact (%)	Conclusion
R15	**5.96**	**Critical first tier**
R8	**5.83**	**Critical first tier**
R1	3.55	First Tier
R2	2.71	First Tier
R13	2.60	First Tier
R18	1.95	First Tier
R4	1.47	First Tier
R6	**0.98**	**Second Tier**
R11	**0.72**	**Second Tier**
R12	**0.51**	**Second Tier**
R17	**0.43**	**Second Tier**
R7	**0.37**	**Second Tier**
R20	(0.26)	Third Tier
R19	(0.73)	Third Tier
R14	(0.74)	Third Tier
R5	(1.12)	Third Tier
R16	(1.90)	Third Tier
R9	(2.80)	Third Tier
R3	(2.99)	Third Tier
R10	(4.00)	Third Tier

(Authors estimation)

The called critical factors, or factors with mean can be observed to have the most impact over the sample of projects studied. They are "R15: Procurement delay" and "R8: Lack of counterpart funds or delay First Tier, Second Tier Critical in allocation", and both risk factors are proven to have an expected impact on a typical project of at least 5% schedule delay. These factors are highly recommended to be carefully reviewed for every project with similar characteristics. As an important note, it can be pointed out that those two risk factors are under weighted impact greater than 5%, are the factors that

the direct control of the implementation agency. Risk factors in the "First tier", with weighted impact greater than 1%, are assumed to have been important in previously implemented projects and there is evidence that they negatively impacted the project's outcome. Factors in the "Second tier", with weighted impact between 0.25 and 1%, are assumed to have moderate importance in previous projects implementations and therefore is worth noting them. Risk factors with weighted impact below

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0.25% are assumed to have no effect in project's performance, historically. In addition, an important note about the results presented in Table 3c is that the weighted impact values calculated are a product of mean impact and relative frequency in equal proportions. It was defined that both components were important to obtain a two dimensional variable to rank the importance of each risk factor.

However, this assumption of equal proportions may or may not work as a reference for all owners. While both components are important, some users may find more important factors with high impact and medium frequency than otherwise.

3.2.2.3 Sensitivity Analysis*:*

This is often considered to be the simplest form of risk analysis. It determines the effect on the whole project of changing one of its risk variables such as delays in design or the cost of materials. Its importance is that it often highlights how the effect of a single change in one risk can produce a marked difference in the project outcome.

Sensitivity analysis is a tool used to also appraise project justifying the need for accepting a project or rejecting it, with a view to mitigate risk and cost reduction for the project to achieve the maximum benefit as detailed in the project objectives, such feasibility and decision appraisal criteria will include but not limited to the following;

Net Present Value (NPV), Benefit Cost Ratio (B/C), the Internal Rate of Return (IRR) and the Pay Back Method (PBM). (Linter 1972pp.145-149)

Hypothetically, if a certain project has the following cash flows

Year	Benefit	Cost	Discount rate
0	0	250	10%
1	125	125	10%
2	250	50	10%
3	375	75	10%

Net Present Value (NPV)= $\sum_{t=0}^{n}\frac{B_t}{(1+r)^t}-\sum_{t=0}^{n}\frac{C_t}{(1+r)^t}=\sum_{t=0}^{n}\frac{B_t-C_t}{(1+r)^t}$ .... (1)

$$\sum_{t=0}^{n}\frac{B_t}{(1+r)^t} = \frac{0}{(1.1)^0}+\frac{125}{(1.1)^1}+\frac{250}{(1.1)^2}+\frac{375}{(1.1)^3} = \mathbf{602.1}$$

$$\sum_{t=0}^{n}\frac{C_t}{(1+r)^t} = \frac{250}{(1.1)^0}+\frac{125}{(1.1)^1}+\frac{50}{(1.1)^2}+\frac{75}{(1.1)^3} = \mathbf{461.2}$$

$\mathbf{NPV} = \mathbf{602.1-461.2=140.9}$ which is greater than zero, this implies that the project is worthy to be undertaken because is economically viable. The decision criteria for the feasibility of the project, taking into account risk analysis implies that if the NPV is greater zero, we execute the project, if lessthan zero we reject the project and if equal to zero we are at breakeven point, in such a circumstance we are indecisive as to whether to execute such project or not. Taking into account sensitivity analysis of risk management it is always advisable to avoid the result of breakeven point.

Further decision criteria could be linked to the benefit/cost ratio, in the above example, the $\frac{B}{C}$= 602.1/461.2 =1.30, which is greaterthan one, thus if the benefit cost ratio is greaterthan one we accept the project, if lessthan one we reject and if equal to one we are indecisive to execute the project, we can also infer to the Internal Rate of Return (IRR) this defines the discount rate that will set the NPV to zero. Therefore the IRR $= \sum_{t=0}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=0}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} = 0$, knowing B and C we can find r? By inspection r=10% (**Authors estimation)**

3.3 Risk Treatment

- This involves using the information collected during the risk analysis phase to make decisions on how to improve the probability of achieving project objectives.
- Usually incentives to reduce the number of fatalities (barricades, signage), are put in place in the actual work zones during construction, physical traffic calming measures. However, this can only be effective when followed by enforcement.
- It may prove more efficient and effective to use innovative contracting and project administration to address work zones safety in the planning, design, pre-construction phases of the project as well as broadcasting, education and sensitization programs for public awareness about the construction work zone. (Bushman, 2012: Arnold, 2004).

Usually, risk treatment can do one or a combination of five things:

- **Remove**- risks that can be eliminated from the project and therefore no longer propose a threat
- **Reduce**- risks that can be decreased by taking certain actions immediately.
- **Avoid**- risks that can be mitigated by taking contingency actions should they occur.
- **Transfer**- risks can be passed on to other parties; unfortunately this does not normally eliminate the risk it just makes someone else worry about it.
- **Acceptance**- the benefits that can be gained from taking the risk should be balanced against the penalties. All risk systems must ensure as a minimum effective and efficient operation of the organization and effective internal controls and observance of current laws and regulations.

3.3.1 Risk Monitoring and Control

- Risk monitoring and control is the process of keeping track of the identified risks, monitoring residual risks and identifying new risks, ensuring the execution of risk plans, and evaluating their effectiveness in reducing risk.
- Risk monitoring and control records risk metrics that are associated with implementing contingency plans. Risk monitoring and control is an ongoing process for the life of the project.
- The risks change as the project matures, new risks develop, or anticipated risks disappear.

Good risk monitoring and control processes provide information that assists with making effective decisions in advance of the risk´s occurring. Communication to all project stakeholders is needed to assess periodically the acceptability of the level of risk on the project (Garber, 2002: Huaman, 2007)

4.0 Conclusion

The study seeks to investigates the factors responsible for project failures particularly in the highway construction projects within the frame work of risk identification, risk assessment, analysis, treatment, monitoring and control using Fuzzy linguistic approach, Kendal's Concomitant Rank Approach and Sensitivity analysis. The study however, noted that the practical experience and intuition of the project analyst, the interdependencies between risks and the surrounding project environment, enabling the project management analyst to express experience on each individual risks, thereby producing a more realistic risk assessment on project risk level.

The study identifies critical primary factors that contribute to work zone crashes involving injuries or fatalities and the mitigating strategies have been focused on physical measures taken during construction, some of these factors include but not limited to the following; speed, inattentive driving, following distance, aggressive /dangerous driving and large trucks (Roadway safety foundation, 2007). The study noted that accurate information needs to be collected during the risk analysis phase to make informed decisions on how to improve the probability of achieving project objectives.

Finally, Project implementation/execution should be aimed at focusing on specific; measureable; achievable; realistic and time bound alternative scenarios and the risk management approach should provide the framework for strength, weaknesses, opportunities and threats. The goal of risk management is primarily to capture project performance towards project objectives. It also assists in contingency tracking and resolution of risks throughout the project life cycle. Despite, the qualitative assessments of risk management approaches, the study is still relevant and provides solid foundation of achieving broad based stability in the project cycle development and project risk management. On this basis, the author looks forward to a more extensive study on the topic with a view to further provoke policy discourse. An interesting area worth researching is the nexus between risk management and insurance institutions. Such a study might guide and inform policy makers as to how to handle risk prudently in the insurance industry and hence economic growth.

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